## REMARKS

The allowance of claims 3 and 12 are noted appreciatively by the applicants. AS will become evident from the discussion which follows, all pending claims herein are in condition for allowance and thus favorable reconsideration of this application is requested.

### 1. Discussion of Amendments

By way of the amendment instructions above, appropriate application headings have been inserted into the specification. Accordingly withdrawal of the specification objection is in order.

The prior pending claims have also been revised in an effort to clarify the claimed subject matter and to define the present invention patentably over the applied prior art. In this regard, the pending claims have been amended so as to emphasize that a ***rotary kiln*** is provided having a kiln wall which defines a combustion zone therewithin. The kiln is also required to have a burner which comprises at least a burner tube having a front end and a discharge end, the discharge end being located outside the kiln wall of the rotary kiln and extending therefrom through the kiln wall into the rotary kiln to the discharge end located inside the rotary kiln within the combustion zone thereof. A burner lance is provided for introducing fuel ***into the burner tube*** for combustion with primary air to generate a flame ***at the discharge end of the burner tube*** within the combustion zone of the rotary kiln. A flue gas is generated by a gas turbine located outside the kiln wall which in turn is directed to the burner tube so that the flue gas is used as primary air for combustion of the fuel introduced into the burner tube by the burner lance where it is combusted with the fuel as primary air to generate a flame at the discharge end of the burner tube in the combustion zone of the rotary kiln.

Support for the claim amendments can be found throughout the specification as originally filed by reference to Figs. 1-3 and the textual description of the same.

Claims 13-18 are new and define that the burner lance is concentrically positioned within the burner tube (see page 3, lines 23-25 and Fig. 1); the burner lance feeds fuel into the burner tube at the discharge end thereof (original claim 3 and page 3, lines 21-23); and that the burner lance feeds fuel into the burner tube at the front end thereof for mixing with the flue gas as primary air directed to the burner tube from the gas turbine by the connecting tube (page 3, lines 25-28).

Therefore, upon entry of this amendment claims 1-18 will remain pending herein. Favorable reconsideration of such pending claims is solicited.

## 2. Response to 35 USC §112 Rejection

The amendments made to the pending claims herein are believed to cure the issues raised by the Examiner under 35 USC §112, second paragraph. Withdrawal of such rejection is therefore in order.

## 3. Response to 35 USC §103 Rejection

Claims 1-2 and 4-11 attracted a rejection under 35 USC §103(a) based on Moreno (USP 4,784,600) in view of DE '683 (DE 3530683). Applicants suggest that such a combination of references is inappropriate against the pending claims herein.

The Examiner has referred to Figure 1 of Moreno, the background of the process being described more fully in USP 4706612 (Moreno) as follows:

> "Thermally enhanced oil recovery (TEOR) processes are applied to oil field production in order to extract heavy, viscous, crude oil and tar sands which cannot otherwise be produced. TEOR involves injection of wet steam, which is produced by combusting crude oil in an oil field steam

> generator typically ranging in size from 7-15 MW capacity. More than 90% of all oil field steam generators in the U.S. are located in California, two-thirds (approximately 1,000 units) of which are located in Kern County. Approximately one-third of the produced crude oil is consumed by the steam generator, amounting to over 100,000 barrels of crude oil consumed per day at full capacity. The crude oils which are fired in these steam generators are typically high in nitrogen (≈ 0.82 to 1.0%) and sulfur content. Uncontrolled emissions of $NO_x$ can, therefore, reach high levels and potentially worsen ambient air quality.
>
> Emissions of $NO_x$ can be minimized by application of a staged combustion process in which the first or primary combustion stage is thermally isolated and provides long residence time under high temperature, optimally fuel-rich conditions. Combustion products, resulting from the first stage combustion process, are fed into a secondary combustor in which additional air is added to complete the combustion process.
>
> It has been proposed to combine a power production stage in the form of a gas turbine, fired with the crude oil and air, ahead of the staged combustor and to use the exhaust of the turbine as the supply of combustion air to the primary and secondary combustion stages.
>
> Steam is generated by running water through boiler pipes lining the interior surface of the second stage combustor and by running water through finned boiler pipes in a convection stage which follows the second stage combustor. The exhaust temperature at the output of the convection stage is approximately 400°F., whereas the turbine exhaust is approximately 1200°F. and temperatures in the primary and secondary combustion combustors are on the order of 2800° to 3000° F. "

The process of Moreno relates to a two stage combustor for use in oilfields. An oil-fired turbine 11 is coupled to a generator for generating electrical power and producing exhaust gases at about 1200 °F (649 °C) containing approximately 15% oxygen. A portion of the exhaust gas is fed into the air intake 12 of a primary combustion chamber 13, of a two-stage combustor 14 wherein the turbine exhaust is

mixed with fuel comprising heavy nitrogen containing crude oil. Combustion conditions in the primary combustion chamber 13 are arranged so that the fuel and air in the turbine exhaust burn in the primary combustion chamber in a fuel-rich manner, i.e., with 70% or less stoichiometric oxygen. The turbine exhaust is fed into the primary combustion chamber through a plurality of swirl vanes arranged for imparting a moderate, to the flow of gases in the primary combustion chamber 13. This causes the primary gas stream to expand and to increase the residence time within the primary combustion chamber 13. The flame temperatures within the primary combustion zone typically reach temperatures of between 2800 °F and 2900 °F.

The hot combustion gases exit the primary combustion chamber 13 through a transition region 15 which includes a constrictor portion 16, then exit through a throat portion 17 into the secondary combustion chamber 18. The secondary combustion chamber 18 includes water boiler pipes 19 lining the interior of the secondary combustion chamber 18 for removing heat from the secondary combustion chamber and for converting the heat into steam which is drawn off at 21. The remainder of the turbine exhaust is fed, as secondary air, into the entrance to the secondary combustion chamber 18 in a flow pattern coaxially surrounding the outer periphery of the primary gas stream exiting the primary combustion chamber 13, at the exit of the throat portion 17.

In our opinion our system differs from the Moreno system which is a low $NO_x$ emission staged combustion burner of the type having a primary combustion chamber followed by a secondary combustion chamber. Thus the primary combustion chamber 13 of Moreno most certainly is ***not*** a burner tube extending into a rotary kiln. Moreno has nothing to do with a burner for a rotary kiln, and thus can in no way solve any problems related thereto.

The applicant's claimed invention relates to a method and rotary kiln having a burner for generating a flame in a combustion zone of the rotary kiln. Thus, in certain preferred embodiments, the only air needed for stabilizing and forming of the flame is produced in the gas turbine, which does not produce electricity or heat for purposes other than rotating the turbine itself. In rotary kilns only so-called primary air is typically directed through the burner, which primary air is necessary for igniting, stabilizing (stabilizing meaning that the fuel inflames instantly at the burner end and the ignition point remains stable, i.e., without swaying) and forming of the flame. The proportion of primary air varies depending on individual burners and applications, but most typically it is 10-40 % of the total volume of combustion air. As is known, the primary air is led to the burner via a fan of its own. However, the current primary air arrangements do not always provide for the desired results in view of both flame control and heat economy of the kiln. Moreover, the ever more exacting environmental requirements set increasingly tight limits to nitrogen oxide emissions. For example, reducing the amount of primary air typically results in a decrease in nitrogen oxide emissions, but at the same time complicates controlling the form of the flame, as well as adjusting the center of combustion. These, in turn, are factors, which have an effect on e.g. the heat economy of the process. An object of the present invention is to provide a method and a burner for more efficient controlling of combustion in a rotary kiln, such as a lime kiln, at the same time resulting in decreased detrimental emissions, e.g. nitrogen oxide emissions, compared to prior art systems. Moreno simply does not deal with rotary kilns and how to generate a flame therein.

DE '683 describes a process in which a flame-forming primary gas is passed through the burner of a rotary kiln. According to DE '683 the primary gas, in comparison to air, is low in oxygen. The main solution described in DE '683 is the use of gas produced elsewhere in the process -- primarily exhaust gas from the rotary kiln or heat exchanger. Additionally DE '683 mentions as a second method an auxiliary small burner, wherein a similar gas is purposely generated to be used as primary air in the

burner. The possible construction and process of this "small burner" are not described more exactly. The expression "separate small burners" is vague. In any case, in the applicants' claimed invention, the gas turbine is one that is stationary and integrated in the burner tube. In the applicants' view, a gas turbine is more than just a "burner", because it can as such produce the primary air for the burner tube. According to DE '683, the oxygen content of the gas must be at a maximum of 15%. However, a separate burner alone does not typically provide for this, but instead the gas has to be cooled prior to the main burner (burning without cooling produces a gas having a temperature of about 700 $^0$C, if the oxygen content is 15%). With lower oxygen content, the gas is hotter.

The claims of DE '683 limit the temperature and the oxygen content of the gas: 80-330 $^0$C and 2-15%. One aspect of the present invention is that a higher temperature higher temperature, e.g., 400-800 $^0$C may be obtained. The oxygen content according to the present invention can be 15-16%, i.e. higher than that employed in DE '683. The oxygen-content (lower than the oxygen-content of air) is not a primary air as such, but a result from the desire to generate a hot gas having a relatively high velocity after exiting the burner. When this is done by means of a gas turbine, consumption of oxygen is inevitable. If the temperature of the gas would remain at 330 $^0$C or lower, the advantage of the burner solution would be nonexistent, if compared to the current, widely used technology with a typical temperature of primary air in the range of 150-200 $^0$C. The temperature of the exhaust gases from the turbine in the Moreno system is also high, i.e. 1200 °F (649 °C), and in the system of DE '683 the temperature is substantially lower. Thus the DE '683 reference teaches against use of the Moreno system.

Consequently, DE '683 does not suggest or teach that "a separate small burner" could be a gas turbine. Neither can applicants see a reason why an ordinarily skilled person would combine the Moreno with DE '683 because they relate to different

apparatuses having different problems. The presently claimed invention relates to flame generation in a rotary kiln by means of a burner. An ordinarily skilled person would not arrive at the present invention simply by substituting a rotary kiln for the steam generating furnace of Moreno.

Withdrawal of the rejection advanced under 35 USC §103(a) based on Moreno and DE '683 is therefore in order.

## 4. Fee Authorization

The Commissioner is hereby authorized to charge any deficiency, or credit any overpayment, in the fee(s) filed, or asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Account No. 14-1140.

Respectfully submitted,

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